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predicted eighty-six minutes, while if the "last seen" and "first seen" really refer to corresponding phases, the predicted time of conjunction is nearly correct.

But important as these two observations will ultimately be for determining the extent of the shadow section, they must be supplemented by corresponding observations of eclipses occurring towards the ends of cycles, in order to allow further inferences to be drawn. The only observation near the end of the last cycle which I have yet seen is a one-sided one, a disappearance observed 1880, May 30, by Tebbutt at Windsor, New South Wales (*Astron. Nachr.*, No. 2,541), from which it may be inferred that the tabular longitude of the node requires a sensible positive correction, as the measurements of Bessel and of Schur had already rendered probable. Observers ought to be on the alert early in 1886 to get complete observations of some of the last eclipses in the present cycle.

Observations of Sun-spot Spectra in 1883. By the Rev. S. J. Perry, F.R.S.

The daily routine work at Stonyhurst Observatory has now for some years included a careful drawing of the solar surface on every available occasion, and also a complete measure of the Sun's chromosphere. Since 1882 a spectroscopic examination of Sun-spots has been added to the previous solar work, but attention has been directed exclusively to the red end of the spectrum, from D to B, as the more refrangible portion is being already carefully studied by others. The following paper is a synopsis of the observations made during the past twelve months, and will, it is hoped, present the results in the most simple form for comparison with the work of other observers. In numbering the lines seen widened or darkened in the spots, the figures published in the British Association Report for 1878 have been followed throughout, and the numbers of both Kirchhoff and Ångström are given for the convenience of reference. The instrument used in these observations is an automatic spectroscope of Browning, in which a dispersion of 2, 4, 6, 8, 10, or 12 prisms of 60° can be readily obtained, and a Christie half-prism has been adapted to the original spectroscope, by which the dispersion previously obtained can be trebled. The figures in the columns headed "widened" and "darkened" will not give averages, as clouds often stop an observer in the middle of his scrutiny, and then only a small proportion of the affected lines may have been noted.

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Table I.

Lines between B *and* D *observed in Sun-spot Spectra.*

No.	Kirchhoff.	Ångström	Number of times Widnd.	Darknd.	Elements.	Remarks.
1	592·7	6867·1		2		B.
2	601·2	43·8		3	Sn	
3	641·0	6717·16	1	3	Ca	
4	654·3	6677·6	2	3	Ba	Chromosphere line.
5	659·3	63·1	2	3	Fe	
6	665·7	43·1	2	3		
7	669·5	33·3	2	3		
8	682·8	6593·3	3	5	Bi, Fe	
9	683·1	92·6				
10	685·3	85·9	2			
11	689·8	74·0	2	3	Fe	
12	690·9	71·4	2			
13	692·1	67·9	2			
14	694·1	62·10	1		H	C twice weakened in spot, once reversed.
15	702·1	43·23	2	3	Fe, Ti	
16	711·4	15·80	3	3		
17		6495·12	11		Fe, Ba, I	
18		94·18				
19	723·7	82·79	6		N	
20	726·7	74·85	6			
21	731·7	61·98	1		Ca, Sb, Cd, Cr	
22	740·9	38·35	2		Ca, Cd	
23	756·9	6399·28	3	2	Fe	
24	759·3	92·87	2	2	Fe, Sb	
25	809·5	6277·09	2		An	
26	809·9	76·32				
27	838·2	6215·67	2		Ti, Fe	
28	838·6	14·30				
29	839·2	12·55				
30	849·7	6190·71	2	3	Fe, Sb, C, E.	
31	859·7	69·59	9	1	As, I	
32	860·2	68·48	1		Ca	
33	861·6	65·62	1		N	
34	863·9	62·69	15		Ca, Rb	
35	864·4	61·40				

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No.	Kirchhoff.	Ångström.	Number of times Widnd.	Darknd.	Elements.	Remarks.
36	874·3	40·81	4	4	Ba, Zr	
37	876·5	36·82	13		Fe	
38	877·0	35·82				
39	884·9	21·34	15		Ca, Co	
40	894·9	01·92	15		Ca, Zn, Li	
41	906·1	6077·80	3		Fe, Sb, As	
42	912·1	64·70	3	3	Fe, Ti, Ba	
43	916·3	55·29	2		Fe, Cd, Bi	
44	1002·8	5895·13	12		Na	D, once weakened in spot.
45	1005·0	92·10	2		Ni	
46	1006·8	89·12	12		Na	D,, once weakened in spot.
47	1029·3	56·60		2	Ca, Ni, Mo, Pb, Se, Te	

The Ba line W.L. 6677·6 deserves special notice, as it has been seen several times in the chromosphere during the course of last year, and it is also a marked feature in the spot-spectra.

The chromosphere line K 534·0, which has been occasionally observed in 1883, lies between *a* and B, and is therefore outside that portion of the spot-spectrum which is recorded at this observatory.

In Table II. I have thought it advisable to give the measurements (taken almost entirely from Watts's Index of Spectra) of each element entered in the last column of Table I., in order that the grounds on which their identification rests may be apparent at a glance. In the subjoined list I have included those lines only whose wave-length falls within a tenth-metre of a well-attested measure of some line of an element, or those which are between measures by approved observers, and in estimating the positions of the spot-lines a dispersion of six prisms of 60° has been generally employed, although ten and even twelve have been occasionally tried.

The presence of Ti, Ba, and Ni in sun-spots can scarcely be considered doubtful, although less well-established than that of Fe, Ca, Na, or H. But all the remaining elements decidedly require confirmation; and although some of them rest on very slender foundations, still I have thought it best to adhere strictly to the simple rule of admitting all that satisfy the condition of not differing in their position more than a tenth-metre from the best available measures of the bright lines of the respective elements. From the drawing up of this list it must not be supposed that the evidence adduced would appear to warrant the admission of each named element among solar lines, but it may still be useful to place such close coincidences on record. To avoid needless repetition the authority for each coincident line may be found noted under the special element.

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Table II.

[*Elements observed in the Spectra of Sun-spots between* B *and* D.

Element.	Line in spot.	Huggins.	Thalén.	Kirchhoff.	Plücker.	Other Authorities.	Coincident Elements.
Fe	6663·1					A.	
	6593·3						Bi
	92·6					B.	
	74·0					A.	
	43·23					A.	Ti
	6495·12	6497				G.	Ba
	94·18		6490	6490		A.	I
	6399·28	6400	6399	6399		A.	
	92·87					A.	
	6212·55					A.	
	6190·70	6190	6190	6190		A.	Sb, C, E
	36·82	6138					
	35·82		6136	6136		A.G.	
	6077·80					A.	Sb, As
	64·70		6065	6065		A.	Ti, Ba
	55·29					A.	
Ca	6717·16	6710		6722		A.	
	6461·98	6458	6462	6462		A.G.	Sb, Cd, Cr
	38·35	6434	6438	6438		A.G.	Cd
	6168·48		6168	6167		A.G.	
	62·69	6163					
	61·40		6161	6161		A.G.	Rb
	21·34	6116	6121	6121		A.G.	Co
	01·92		6102	6101		A.G.	Zn, Li
	5856·60	5854	5857	5857		A.G.	Ni, Mo, Pb, Se, Te
Na	5895·13	5895	5895	5895		A.G.	
	89·12	5889	5889	5889		A.G.	
H	6562·10	6562	6562		6562	A.	
Ba	6677·6	6677					
	6495·12	6499	6496	6497		A.G.	Fe
	6140·81		6141	6141		A.G.	Zr
	6064·70	6064	6062	6063			Fe, Ti
Ti	6543·23		6543				Fe
	6214·30		6214			A.	
	6064·70		6064			A.	Fe, Ba
Ni	5892·10		5892	5891		A.	
	5856·60		5856	5856		B.	Ca, Mo, Pb, Se, Te
N	6482·79	6482	6480	6480			

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Element.	Line in spot.	Huggins.	Thalén.	Kirchhoff.	Plücker.	Other Authorities.	Coincident Elements.
	6165·62				6165 6162 band		
Au	6277·09					B.	
	6276·32	6276	6276	6275			
Sn	6843·8			map			
Bi	6593·3		6599				
	92·6	6590					Fe
	6055·29	6055	6050				Fe, Cd
Sb	6461·98	6461					Ca, Cd, Cr
	6392·87	6392					Fe
	6190·71	6189	6193				Fe, C, E
	6077·80	6076	6078	6080 6076			Fe, As
Cd	6461·98	6462	6466	6468 6462			Ca, Sb, Cr
	6438·35	6433	6438	6438		Mascart, 6437	Ca
	6055·29	6050	6056				Fe, Bi
As	6169·59			map			I
	6077·80	6078					Fe, Sb
I	6494·18				6494		Fe
	6169·59				6169		As
C	6190·71					Watts, 6190	Fe, Sb, E
Co	6121·34		6121	6121			Ca
Cr	6461·98	6461					Ca, Sb, Cd
E	6190·71		6190				Fe, Sb, C
Li	6101·92	6096	6102	6101			Ca, Zn
Mo	5856·60		5857				Ca, Ni, Pb, Se, Te
Pb	5856·60	5853	5856				Ca, Ni, Mo, Se, Te
Rb	6161·40			map			Ca
Se	5856·60				5856		Ca, Ni, Mo, Pb, Te
Te	5856·60	5854	5856				Ca, Ni, Mo, Pb, Se
Zn	6101·92	6100	6102	6106 6099			Ca, Li
Zr	6140·81		6140				Ba

Abbreviations.

A is Angström's Spectre Normal du Soleil.
G is Greenwich Observation of a Sun-spot, 1879.
B is Burton's Catalogue in Brit. Assoc. Report, 1878.

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Remarks on Mr. Hilger's Illumination of Micrometers with Vacuum Tubes. By Dr. N. de Konkoly.

I read in No. 82 of the *Observatory* that Mr. Hilger exhibited at the January meeting of the Society a micrometer with vacuum tube illumination.

In the year 1875 I made such a micrometer illumination, but soon discontinued its use, because of the unpleasant shocks which I received from the induction current. I had the eyepiece diaphragm made of ebonite, but then received the shocks in the hand on turning the micrometer. The vacuum tube was entirely enclosed in an ivory and ebonite case on account of the induction current producing such unpleasant shocks. In front of the wires was a very small circular vacuum tube which was kindly made for me by my friend, Professor Lengyel, of the University of Buda-Pest. The wires were bright on a dark ground, and the illumination was very good, without any diffused light in the field, but was unpleasant on account of the tremulous light produced by the interruption of the current. I also illuminated the field of view, so as to produce black wires on a bright ground. My telescope being of metal, we still experienced shocks and also a tremulous light. The shocks might have been avoided by making the eyepiece diaphragm and the button of the micrometer-screw of ebonite, but it was not possible to prevent the tremulous light.

I saw a few weeks ago such a micrometer by Mr. Hilger in the observatory of Cardinal Haywald at Kalocsa, but Dr. Braun, the Director of the Observatory, had also rejected the vacuum tube on account of the tremulous light and the shocks which were received every moment.

I have now illuminated all my micrometers with very small incandescent (Swan) lamps, both on the telescope and spectroscopes. I can obtain from M. Müller, of Hamburg, very small Swan lamps of $\frac{1}{4}$-inch diameter, of 1–2 volts electro-motive power, so that they can be put in action by one or two Bunsen cells or a very small accumulator. The light is very steady, and can be easily regulated by applying different resistances to the current, or by employing diaphragms of oiled paper.

I have made use of this arrangement in my observatory for half a year, and think that no one who has tried the method would ever employ vacuum tubes or oil lamps.

I should be pleased to give photographs or drawings of my improved arrangements to anyone who is interested in the subject.

I may add that M. E. de Gothard has illuminated all the micrometers in his private observatory at Herény on my system.